U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-286 204

Water Quality Monitoring: Philippines, Republic of Korea, Japan, Malaysia, New Zealand, Australia, Guam

World Health Organization, Manila (Philippines)

Prepared for

United Nations Environment Programme, Nairobi (Kenya)

24 Feb 78

PB 286 204

WORLD HEALTH ORGANIZATION

ORGANISATION MONDIALE DE LA SANTÉ

REGIONAL OFFICE FOR THE WESTERN PACIFIC
BUREAU RÉGIONAL DU PACIFIQUE OCCIDENTAL

ICP/CEP/009-E

24 February 1978

ENGLISH ONLY

ASSIGNMENT REPORT

15 September - 28 November 1977

by

Robert L. Fox, Jr.
WHO Consultant

Title of project	:	Water quality monitoring
Location	:	Philippines, Republic of Korea, Japan, Malaysia, New Zealand, Australia, Guam
Participating agencies	:	UNEP/WHO/WMO/UNESCO and Member Countries
Form of cooperation	:	Advisory services
Source of funds	:	UNEP

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

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TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
ICP/CEP/009-E		PB285204

4. TITLE AND SUBTITLE	5. REPORT DATE
Water Quality Monitoring: Philippines, Republic of Korea, Japan, Malaysia, New Zealand, Australia, Guam	February 24, 1978
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
Robert L. Fox, Jr.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
Regional Office for the Western Pacific World Health Organization P.O. Box 2932 Manila, Philippines	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
United Nations Environment Programme Nairobi , Kenya	Assignment Report
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The purpose of this project was to establish the basic groundwork for country participation in a global fresh water monitoring project sponsored by UNEP/UNESCO/WHO/WMO. The project complements the existing global air quality monitoring project in providing an earth watch network under the Global Environmental Monitoring System (GEMS). Visits were made to seven participating countries during the period 15 September to 28 November 1977 to:

a) provide expert advice by reviewing present water quality monitoring programs in selected member countries;
b) assist in establishing programs in conformity with the GEMS project, covering the following elements:
   i) site selection, water quality sampling and hydrological guaging,
   ii) parameters for monitoring,
   iii) analytical methods, including laboratory quality assurance,
   iv) water quality data handling systems.
c) assist in preparing national cooperative project structures, based on the above.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Water quality management Water pollution sampling International agreements Global analysis	Global Environmental Monitoring System (GEMS), Philippines, Republic of Korea, Japan, Malaysia, New Zealand, Australia, Guam	

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Distribution unlimited	unclassified	52
	20. SECURITY CLASS *(This page)*	22. PRICE
	unclassified	A04 - H01

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

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1. INTRODUCTION AND PURPOSE OF PROJECT

The purpose of this project was to establish the basic groundwork for country participation in a global fresh water monitoring project sponsored by UNEP/UNESCO/WHO/WMO. The project complements the existing global air quality monitoring project in providing an earth watch network under the Global Environmental Monitoring System (GEMS).

Visits were made to seven participating countries during the period 15 September to 28 November 1977 in order to fulfill the detailed terms of reference of the project, as follows:

(a) provide expert advice by reviewing present water quality monitoring programmes in selected Member Countries;

(b) assist in establishing programmes in conformity with the GEMS project, covering the following elements -

(i) site selection, water quality sampling and hydrological gauging,

(ii) parameters for monitoring,

(iii) analytical methods, including laboratory quality assurance,

(iv) water quality data handling systems,

(c) assist in preparing national cooperative project structures, based on the above.

2. CONDUCT OF PROJECT

The project involved visits to the appropriate water quality and hydrological monitoring agencies in seven countries which had indicated an interest in participating in the GEMS project. The countries visited were the Republic of the Philippines, Republic of Korea, Japan, Malaysia, New Zealand, Australia and Guam. In each country discussions were held with key monitoring agency personnel and work was initiated on completing detailed country information sheets. These sheets summarize existing water quality monitoring activities, indicate laboratory capabilities, and describe individual water quality monitoring sites in rivers, lakes and groundwaters which have been proposed for inclusion in the GEMS network. They will be submitted as a separate package to the WHO Regional Office for the Western Pacific.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Proposed GEMS network in countries visited

An initial network in the seven countries visited is proposed which is composed of 44 stations and 29 laboratories.

3.2 Regional collaborating centre

The Institute of Public Health in Japan has expressed strong interest to serve as the regional collaborating centre for the GEMS project in the Western Pacific Region. Because of the Institute's previous involvement in the initial development of the project, through Dr Shoichi Nambu, Director of the Department of Sanitary Engineering, and because of the availability of capable supporting staff at the Institute, it has good potentials for the regional collaborating centre.

The Guam Environmental Protection Agency laboratory has an operational quality assurance programme with the United States Environmental Protection Agency and may be able to assist as a regional collaborating centre. As the Philippines have an operational water quality data storage and retrieval system adopted from the Canadian NAQUADAT System, they may be available as the regional collaborating centre for this purpose.

3.3 Quality assurance

The achievement of proper quality assurance procedures throughout all aspects of the GEMS project will probably pose the greatest difficulty in meeting the project goals. Quality assurance in the collection of water samples is considered to require the most attention, with analytical quality assurance also requiring substantial assistance in some laboratories. Improved quality assurance practices are most needed in the Republic of the Philippines, the Republic of Korea, and Malaysia.

3.4 Training

3.4.1 Future training activities should be oriented toward the development of improved techniques of water sampling and analysis (including stream flow measurements) in order to produce high quality data. It should be emphasized that, to be most effective, the training should be conducted as nearly as possible under real-life working conditions. Countries having the greatest need for training in the areas mentioned above are the Philippines, the Republic of Korea, and Malaysia.

3.4.2 At least two countries in the Region, New Zealand and Australia, have instituted training programmes covering the areas of water sampling and analysis and may be able to provide assistance in the development of future regional training programmes.

3.4.3 Based on the staff and facilities available at the proposed PERAS centre at the Universiti Pertanian Malaysia in Kuala Lumpur, Malaysia, the centre may be a promising future location for conducting training courses covering various aspects of water quality studies.

3.5 Equipment

For operation of the proposed GEMS network in the Region, certain minor items of equipment are required in order to provide data for at least the basic list of global parameters. (see Annex 7). The identified needs are summarized below:

3.5.1 Republic of the Philippines

Department of Health - conductivity meter, ammonia distillation apparatus and chlorophyll measurement apparatus.

National Pollution Control Commission - 44.5°C water bath incubator.

Regional Laboratory at Cagayan de Oro City - analytical balance, furnace for volatile solids analysis.

Laguna Lake Development Authority - 44.5°C water bath incubator.

3.5.2 Republic of Korea

Kyung Ki Do Provincial Laboratory - conductivity meter, furnace for volatile solids analysis, 44.5°C water bath incubator, chlorophyll measurement apparatus.

3.5.3 Malaysia

The Chemistry Department main laboratory at Kuala Lumpur, has no basic equipment needs. Information from the country information sheets should indicate any equipment needs of the participating state laboratories.

3.6 Information needs

Both Australia and New Zealand request further details on the proposed data handling system as soon as possible so that efforts can be made to facilitate the transfer of computerized data between the national and global centres.

4. SUMMARY OF FINDINGS

4.1 Regional overview

Discussions with 47 agencies in seven participating countries in the Western Pacific Region revealed a generally high degree of acceptance and support of the GEMS project requirements. A summary of the proposed regional GEMS network indicating each country's initial involvement in the project is presented in Table 4.1

Table 4.1

Summary of proposed regional GEMS network

Country	Stations	Laboratories	Coordinating agency
Philippines	4	4	National Pollution Control Commission (Tentative)
Republic of Korea	1	1	Ministry of Health and Social Affairs (Tentative)
Japan	14	9	Institute of Public Health
Malaysia	7	5	Ministry of Health
New Zealand	3	2	Department of Health
Australia	13	5	Water Resources Council
Guam	2	3	Environmental Protection Agency
Total	44	29	

A more complete description of each country's participation in the project is presented in the following sections. Additional specific details are contained in the country information sheets submitted separately by each country.

4.2 Republic of the Philippines

4.2.1 Introduction

During the week 26 - 30 September 1977 the GEMS project was discussed with officials of various agencies concerned with water quality management programmes in the Philippines. The agencies visited were:

(1) Department of Health

(2) National Pollution Control Commission (NPCC)

(3) Bureau of Public Works

(4) Laguna Lake Development Authority (LLDA)

(5) Metropolitan Waterworks and Sewerage System (MWSS)

The agencies contacted were generally receptive to the idea of participating in the project, although, in most cases, the initial involvement will be at a fairly low level.

4.2.2 Present monitoring activities

There is no comprehensive country-wide water quality assessment programme being carried out in the Philippines at this time, although the National Pollution Control Commission plans to initiate such a programme as future resources permit. Previous monitoring has generally been for the purpose of special river classification studies rather than for broad, long-term water quality assessment.

The Laguna Lake Development Authority is involved in a comprehensive water quality management study of the Laguna Lake resource area, and through the provision of international assistance, has developed substantial staff and facilities for this purpose.

The Bureau of Public Works conducts stream flow measurements at numerous gauging stations throughout the Philippines, while the Department of Health and Metropolitan Waterworks and Sewerage System are primarily concerned with safe drinking water supplies and sanitary waste disposal.

4.2.3 Proposed GEMS network

A total of four stations have been proposed for inclusion in the GEMS network. A summary of these stations is shown in Table 4.2.3.

Table 4.2.3

Proposed GEMS Network - Republic of the Philippines

Water body	Station location	Operating agency	Comments
La Mesa Reservoir	La Mesa Dam Reservation, Quezon City	MWSS and Department of Health	Manila water supply
Pampanga River	Barrio San Juan, San Simon, Pampanga	NPCC	Multiple use impact measurement
Cagayan de Oro	Cagayan de Oro City and Carmen Bridge	NPCC - Regional Laboratory in Cagayan de Oro City	Multiple use measurement
Laguna Lake	Diablo Pass	LLDA	Future water supply for Manila area Major multi-purpose lake

A brief visit was made to the main water laboratory of each participating agency. Most of the basic water quality parameters requiring analysis under the GEMS project can be conducted by the laboratories. However, some minor equipment is needed in order to conduct several analyses.

Department of Health - conductivity meter, ammonia distillation apparatus and chlorophyll measurement apparatus.

National Pollution Control Commission - 44.5°C water bath incubator.

NPCC Regional Laboratory - furnace and analytical balance.

Laguna Lake Development Authority - 44.5°C water bath incubator.

In addition, proper quality control practices need to be emphasized in each laboratory. Additional information on the specific laboratory capabilities is provided in the country information sheets submitted separately to the WHO Regional Office.

4.2.4 National coordinating centre

Although there has to date been no formal designation of a country coordinating centre, the National Pollution Control Commission is considered to be the logical agency for coordinating the GEMS project in the Philippines. Active involvement in coordinating the project could strengthen the agency's developing programme in water quality management activities.

4.2.5 Additional considerations

(1) A substantial amount of follow-up action by the WHO Regional Office will be necessary since there is presently no interagency working group available for coordinating the activities of the GEMS project. In particular, the operation of the La Mesa reservoir station by two different agencies may require special coordinating attention. It may be that some of the more complex analyses can be done by either the LLDA or the NPCC laboratories, if necessary.

(2) Training in proper techniques of sample collection and laboratory analysis, utilizing accepted quality assurance practices, would be beneficial to all participants in the project.

4.3 Republic of Korea

4.3.1 Introduction

Discussions were held with numerous Korean officials concerning the GEMS project during the period 4-7 October 1977. The agencies visited were the Ministry of Health and Social Affairs, Ministry of Construction, Seoul Metropolitan Institute of Hygiene, National Institute of Health, Duk To Water Treatment Plant, and the Kyung Ki Do Provincial Laboratory. It was noted that the present water quality and steam gauging programmes in the Republic of Korea are gradually being upgraded, but it will take concerted efforts before a comprehensive network producing high quality data is achieved. As a result, it is expected that the country's participation in the GEMS project will be on a small scale initially, with continuous efforts being made to gradually upgrade the participating monitoring stations and laboratories.

Part of the reason for the need to proceed slowly with the project in the country is that there are numerous agencies and departments having either water quality or quantity measurement responsibilities, and the inter-relationships must be carefully and sensitively cultivated. In particular, the Ministry of Health and Social Affairs (responsible for country-wide water quality monitoring), and the Ministry of Construction (responsible for country-wide stream gauging) have been, and should continue to be, encouraged to exchange data to permit a more comprehensive appraisal of water pollution problems.

4.3.2 Present monitoring activities

The Ministry of Health and Social Affairs operates approximately 13 automatic monitors in selected rivers throughout the Republic of Korea. Six of the monitors are reportedly located on the Han River, primarily near Seoul (reference 1, Annex 5). Continuous measurements are made for temperature, pH, conductivity, dissolved oxygen, turbidity and, at some locations, total organic carbon. It is planned to purchase four more automatic monitors next year.

It was difficult to determine the full extent of the water quality monitoring and stream gauging programmes but, for an approximate presentation of the country-wide network, one should consult the maps included with the country information sheets submitted separately to the WHO Regional Office (see Map Index, Annex 6). These maps indicate that approximately 60 water quality sampling sites are operated by provincial laboratories on a routine (monthly) basis.

4.3.3 Proposed GEMS network

After considerable discussion with numerous agencies a single existing station was recommended for possible inclusion in the global network. The proposed station is in Paldong Reservoir on the Han River, a proposed major water supply source serving Seoul and other nearby

cities. Due to the lack of a boat and proper sampling equipment, the present sampling is conducted near the north shore which may not produce samples representative of the main reservoir body. It is therefore recommended that future attempts be made to secure agreement on moving the sampling station downstream from the dam approximately 2 km to the Goan stream gauging site. The water at this location would still be representative of the water proposed for conveyance from Paldong Reservoir to Seoul for potable use.

4.3.4 Laboratory evaluation

The laboratory conducting the routine monitoring programme on Paldong Reservoir is the Kyung Ki Do Provincial Laboratory located near Suwon (approximately 50 kilometers south of Seoul). This laboratory was visited but language barriers prevented a thorough evaluation. However, it was determined that the laboratory is capable of performing most of the basic parameters and some of the more difficult globally-significant parameters. The laboratory expects to take delivery of an atomic absorption spectrophotometer next year, which should greatly increase its capability. Quality control practices could not be ascertained but it is quite probable that little effort is being made. The list of equipment needed in order to conduct the basic GEMS parameters includes a conductivity meter, furnace for volatile solids, 44.5°C water bath incubator, and possibly biological analysis equipment (for chlorophyll and phytoplankton).

4.3.5 National coordinating centre

At this time there has been no formal designation of a national coordinating centre for the GEMS project in the Republic of Korea. It is suggested that the future assigned WHO Adviser on Water Pollution Control (or present in-country WHO staff) serve as liaison and maintain close contact with the two primary agencies involved in the project (Ministry of Health and Social Affairs and Ministry of Construction) until an official coordinating centre is designated.

4.3.6 Additional considerations

(1) A second proposed station which might later be included in the global network could possibly be located near the Jindong gauging station on the Nak Dong River in southern Korea. The Nak Dong is a major river carrying municipal waste from at least three large cities and agricultural runoff from two provinces. Incorporating this station would mean utilizing a second provincial laboratory which was not evaluated at the time of the visit.

(2) It should be emphasized that participation by the Republic of Korea in the GEMS project is only "probable" at this time. The final decision to participate will not be made until the WHO Adviser on Water Pollution Control arrives and can assist in coordinating and advising on the country's participation.

(3) It is probable that many existing environmental programmes now scattered among numerous agencies will be reorganized into a proposed Department of Environment. This should have a beneficial effect on all environmental protection programmes due to better coordination. In addition, there is a proposal for development of a Technical Environmental Institute which would possibly be of significant value in providing technical support and training in environmental studies.

(4) Training in proper field sampling and laboratory techniques (including quality assurance) would be highly desirable. Analytical training would be required before a proposed new atomic absorption spectrophotometer could be placed into operation. Training would also be required before any kind of biological analysis could be undertaken. Due to the language difficulty, training would have to be conducted locally if it is to be of real value.

4.4 Japan

4.4.1 Introduction

Discussions with representatives of the major organizations responsible for water monitoring in Japan were held from 11 to 14 October 1977. Agencies visited were the following: Ministry of Health and Welfare, Ministry of Construction, Environment Agency, Institute of Public Health, and Yokohama Waterworks Bureau. It was immediately evident that Japan is interested in achieving and maintaining high water quality throughout the country. The agencies expressed a strong interest in participating in the GEMS project. An inter-ministerial management committee consisting of 17 members from four organizations interested in water quality and quantity had previously been designated (see the list of committee members and proposed data flow arrangement in Annexes 2 and 3, respectively). The formation of this committee greatly simplified the task of selecting proposed water quality monitoring stations and laboratories by serving as the focal point for clarification and explanation of various issues related to the project.

4.4.2 Existing monitoring activities

A comprehensive water quality and quantity monitoring programme is currently in operation in Japan. The following agencies have major routine monitoring responsibilities: (a) Ministry of Health and Welfare - approximately 2000 water quality stations operated by local water works authorities; (b) Ministry of Construction - approximately 900 water quality and 450 discharge monitoring stations; and (c) Environment Agency - approximately 4000 stations on rivers for monitoring "health related" and "living environment" water quality parameters.

4.4.3 Proposed GEMS network

Table 4.4.3 and Figure 4.4.3 present the proposed GEMS network suggested for Japan by the inter-ministerial management committee working with the consultant. The list includes eight river stations, four lake stations, and two groundwater stations. Arrangements for completing the information sheets for each station will be made by the committee, with the first submission of completed sheets to the WHO Regional Office scheduled for 13 November 1977 and all sheets to be submitted by 1 December 1977. The information sheets will have to be translated into Japanese by the inter-ministry committee and then sent out to the individual waterworks laboratories to obtain the detailed information. All of this information will then have to be retranslated into English by the committee prior to submission to WHO.

Table 4.4.3

Proposed GEMS Network - Japan

No.	Station	Waterbody	Basin	Waterworks Laboratory
1.	Misumai	river	Toyohira River Tributary to (Ishikari River)	Sapphoro City
2.	Urawa	groundwater		Southern Saitama Waterworks Board
3.	Kurihashi	river	Tone River	Tokyo Metropolitan
4.	Kinuta	groundwater		Tokyo Metropolitan
5.	Okusagami	reservoir		
6.	Tsukui	reservoir	Sagami River	Yokohama City
7.	Samukawa	river		
8.	Ojiya	river	Shinano River	Niigata City
9.	Ochiai	reservoir		
10.	Inuyama	river	Kiso River	Nagoya City
11.	Okoshi	river		
12.	Biwa	lake	Yodo River	Osaka City
13.	Hirakata	river		
14.	Yaguchi	river	Ohta River	Hiroshima City

4.4.4 Evaluation of laboratories visited

As noted in Table 4.4.3, nine different waterworks laboratories will be involved in conducting the water quality analyses for the GEMS project. These laboratories are reputed to be among the best analytical laboratories in Japan, and although they are autonomous within their respective geographical areas, coordination of the analytical work and data flow can be achieved through the Ministry of Health and Welfare in Tokyo.

Figure 4.4.3

Map of the GEMS Network - Japan

During this visit, three different water quality laboratories were visited in the Yokohama area, in addition to the Institute of Public Health laboratory in Tokyo. In all cases, the laboratories appeared to be well-equipped, staffed, and managed. In particular, the large number of sophisticated analytical units such as gas-liquid chomatographs, atomic absorption spectrophotometers and electron microscopes was quite impressive. As expressed by the laboratory directors, each laboratory takes pride in doing an excellent job of water analysis. If certain laboratories are not presently conducting tests for all the basic GEMS parameters, they will be instructed by the Ministry to institute the tests wherever possible.

4.4.5 National coordinating centre

The designated national coordinating centre in Japan for all future activities related to the GEMS project is the Institute of Public Health. The primary contact is:

Dr Shoichi Nambu
Chief, Department of Sanitary Engineering
Institute of Public Health
6-1 Shinokanedai, 4-chome, Minato-ku
Tokyo 108, Japan

4.4.6 Proposed regional collaborating centre

Dr Nambu also expressed a strong interest in having the Institute serve as the regional collaborating centre for all GEMS water activities in the Western Pacific Region. Dr Nambu's previous involvement in planning this project and the capable supporting staff at the Institute are two favourable factors in considering the Institute as the regional collaborating centre.

4.4.7 Additional considerations

The Japanese waterworks laboratories do not routinely analyse water for volatile suspended solids and fecal coliform. They would prefer not to run these tests but would do them if required to do so. It was suggested that, for volatile suspended solids, a few tests be made at each station and if the results were consistently low, the analysis could probably be discontinued. They will continue to analyse for total coliforms, but desire more information on the need for fecal coliform testing.

4.5 Malaysia

4.5.1 Introduction

The consulting visit to Malaysia during the period 17-21 October 1977 confirmed the strong interest of several water monitoring agencies in participating in the GEMS project. An ad hoc technical sub-committee, consisting of selected representatives from member agencies of the Malaysian International Hydrological Program Committee, has been formed to assist in coordinating the project (see the sub-committee membership in Annex 4). The sub-committee had arranged a schedule of meetings with the various agencies involved in the project.

A total of eight different agencies were visited during the consultation period:

(1) Division of Environment

(2) Drainage and Irrigation Department

(3) Environmental Health and Engineering Unit, Ministry of Health

(4) Chemistry Department

(5) Forestry Department

(6) Geological Survey Department

(7) Public Works Department

(8) Universiti Pertanian Malaysia

4.5.2 Present monitoring activities

The three primary agencies conducting water quality sampling are the Division of Environment, the Drainage and Irrigation Department, and the Environmental Health and Engineering Unit. The Public Works Department also conducts a routine monitoring programme of raw and treated public water supplies. Most water samples collected by these agencies are analysed in the Chemistry Department main laboratory in Kuala Lumpur or in branch laboratories located in the various States. The Drainage and Irrigation Department is the primary agency responsible for conducting stream flow measurements. It operates approximately 75 permanent stations for stream flow measurements and approximately 55 stations for at least some type of water quality measurements in Peninsular Malaysia (see map 4 in Annex 6, Reference 4, Annex 5). The involvement of the other agencies in water quality monitoring has, to this point in time, been devoted primarily to special river studies addressing specific pollution problems. However, the Division of Environment is gradually developing a comprehensive national water quality monitoring programme with emphasis on determining impacts on water resources in major developing areas.

4.5.3 Proposed GEMS network

A total of seven river water quality monitoring stations serviced by five different laboratories were proposed for inclusion im the GEMS network during a meeting of the interagency GEMS sub-committee at the conclusion of the consulting visit to Malaysia. The proposed station locations are shown on map 4 in Annex 6. A brief summary of the proposed stations and laboratories is presented in Table 4.5.3.

The laboratories to be involved in the GEMS project are all within the Department of Chemistry (reference 3, Annex 5). The main laboratory in Kuala Lumpur was visited, and the overall impression was favourable. There was a good supply of advanced analytical equipment available (gas-liquid chromatographs, atomic absorption spectrophotometers, etc.), and the laboratory director expressed a concern for producing reliable data through proper use of standard methods (the 13th edition of Standard Methods by the APHA was being used). The main water laboratory expects to double its work area next year. It will also be responsible for coordinating a quality assurance programme among the state laboratories when check samples become available through the project.

The country information sheets were distributed and are to be completed by the appropriate sampling and analytical agencies. They will then be sent to the national coordinating centre (Ministry of Health), which will forward them to the WHO Regional Office in Manila. Examples of completed country information sheets were provided to assist in this work.

4.5.4 National coordinating centre

Although the Division of Environment had previously voluntered to serve as the national coordinating centre for Malaysia, the Environmental Health and Engineering Unit in the Ministry of Health was designated as the national coordinating centre by the interagency GEMS sub-committee meeting on 21 October 1977. As it is likely that the Division of Environment will be increasingly active in water quality monitoring in the future, it is important that they be kept informed of future activities of the project and that they actively participate in any future selection of monitoring sites to be included in the GEMS network. The address of the national coordinating centre is:

Environmental Health and Engineering Unit
Division of Health
Ministry of Health
Kuala Lumpur
Malaysia

Table 4.5.3 - Proposed GEMS Network - Malaysia

State	Water Body	Station Location	Operating Agency	Participating Laboratory	Comments
1. Selangor	Klang River	Puchong Weir No. 3015631	Drainage and Irrigation Department	Chemistry Department Laboratory, Kuala Lumpur	Impacts from K. Lumpur area. Urban development, mining, (some industry).
2. Selangor	Gombak River	Km 21 Gombak (JKR) No. 3317636	Public Works Department	- do -	Tributary to Klang River. Raw water supply for K. Lumpur.
3. Negri Sembilan	Linggi River	Water supply intake 5 m upstream from No. 2519621	- do -	- do -	Water supply for Port Dickson, Seremban and coastal area. Highly impacted.
4. Johore	Sekudai River	Water supply intake for Singapore	- do -	Johore Bahru, Chemistry Department Laboratory	Singapore water supply
5. Kedah	Muda River	Jambatan Syed Omar No. 5606610	Drainage and Irrigation Department	Penang Chemistry Department Laboratory	Agricultural impacts. Penang water supply taken downstream.
6. Kelantan	Kelantan River	Jambatan Guillermard No. 5721642	- do -	Kuala Trengganu Chemistry Department Laboratory	Baseline station. Future agricultural and urbanization impacts.
7. Perak	Kinta River	Water supply intake for Ipoh	Public Works Department	Ipoh Chemistry Department Laboratory	Baseline station. Water supply for Ipoh.

4.5.5 Additional considerations

(1) Several agencies indicated a strong interest in receiving training for field personnel involved in collecting water quality samples, conducting certain field analytical tests, and measuring stream flows. Training in these subjects should be given high priority, since it will directly effect the quality of data produced by the project.

(2) The proposed GEMS station on the Sekadai River (#4) is presently operated by the Public Utilities Board in Singapore (PUB) since the river serves as a drinking water supply for Singapore. Arrangements will have to be made for transporting water samples collected by the PUB to the Department of Chemistry laboratory in Jobore where chemical analyses are to be performed.

4.5.6 Report of a visit to the Universiti Pertanian Malaysia

The Universiti Pertanian Malaysia has been proposed as the site for the centre for the Promotion of Environmental Planning and Applied Studies (PEPAS). In order to obtain a general assessment of the Universiti's capability for undertaking water quality studies, a visit to the Universiti was made on 20 October 1977 by Mr P. Lauriault, WHO engineer in Malaysia, and the consultant. Discussions concerning existing and proposed programmes were held with the following staff members: (reference 5, Annex 5).

(1) Dr Arffin Bin Suhaimi, Dean, Faculty of Science and Environmental Studies

(2) Mr Wong Kien Keong, Lecturer, Department of Environmental Studies

(3) Mr Sulaiman Noordin, Head, Department of Environmental Studies

(4) Mr Tan Wee Lee, Instructor, Chemistry Department

The Department of Environmental Studies plans to develop three separate curricula by early 1979 in the areas of solid waste, air pollution and water pollution. At the present time, the water pollution programme is just being developed and there have not been any significant water quality studies conducted. However, there are plans to become quite active in conducting training courses and special research in this area in the future. A total of 11 staff will eventually be available for teaching and research in the three curricula mentioned above (nine staff are presently away studying). The present staff feel that by 1979 a fairly complete water quality laboratory will be available within the Department. If additional technical assistance or equipment is needed it could readily be made available from other Universiti departments (such as the chemistry or biochemistry and microbiology departments - see the following lists of equipment available). Three separate

laboratories were visited in order to gain a general assessment of the type of analytical instruments available for possible use in water quality studies. The findings are shown below:

1. Environmental studies department

Equipment available	Equipment ordered or to be ordered
Furnace	Atomic absorption spectrophotometer
Portable Hach kit	D.O. Meter
Beckman ion analyser	pH meter
Bottom dredge sampler	BOD bottles (2 dozens)
Core samplers (for sediment)	Additional Hach kits
Centrifuge	Gas chromatograph
Noise meter	

2. Biochemistry and microbiology department

Equipment available:

Gas chromatograph
Equipment for conducting
Microbiological analyses

3. Chemistry department

Equipment available

Spectrophotometer (IR, UV)
Gas chromatograph
Atomic absorption spectrophotometer (with carbon rod adaptor)
Carbon - hydrogen - nitrogen analyser
YSI D.O. meter with stir and extension cable
Bausch and Lomb mini-spectrophotometer, portable
Other basic unspecified equipment

The actual site for the proposed PEPAS centre is planned to occupy approximately 5000 sq. ft. in the existing Forestry building. The vacated space was inspected, and it appeared to be a desirable location for the centre. It contains large open areas for conference or training rooms, individual offices with small attached laboratories, and substantial library space. Based on the staff, facilities and equipment available at the proposed PEPAS centre, it appears to be a promising location for conducting training courses covering various aspects of water quality studies (field sampling techniques, laboratory analytical quality control practices, stream flow measurements, etc.).

4.6 New Zealand

4.6.1 Introduction

The consultation visit to New Zealand was made during the period 23-27 October 1977 and included discussion with representatives of the following agencies:

(a) Department of Health

(b) Water and Soil Division, Ministry of Works and Development, Wellington and Hamilton, New Zealand

(c) Chemistry Division, Department of Scientific and Industrial Research, Wellington

(d) Freshwater Section of Ecology Division, Department of Scientific and Industrial Research, Taupo

(e) Commission for the Environment

(f) Auckland Regional Authority

The Department of Health had arranged a detailed schedule for the visit, which included an interagency meeting at the outset to maintain communication among all interested agencies.

Considerable interest in the GEMS project was expressed by most of the persons contacted, although the primary contacts for the project in the Water and Soil Division expressed reservations about part of the project. Because of their experiences in the conduct of highly-advanced water quality studies, they felt that the objectives of the project were too vague and general to provide much meaningful information about the incidence and trends of hazardous water pollutants on a global basis. In addition, they questioned the ability of any data-handling system to produce meaningful analyses of data generated by the relatively few, widespread monitoring stations proposed by the project. Additional information addressing these two points should be made available to New Zealand (Water and Soil Division) as soon as it becomes available. Of particular interest to most agencies in the country was the planned international quality assurance programme. They have been developing and utilizing a quality assurance programme within their own laboratories for sometime. (reference 6, Annex 5).

4.6.2 Present monitoring activities

There are basically three main agencies in New Zealand involved in monitoring ambient water quality.

(1) Water and Soil Division - the emphasis is on the conduct of special water quality studies, often in support of monitoring activities of the regional water boards. A certain number of routine water quality and streamflow measurement stations are maintained. This group will be conducting most of the sampling and analysis connected with the GEMS project.

(2) Regional Water Boards - The boards are primarily involved in routine monitoring related to local water quality problems. The Water and Soil Division is attempting to strengthen these groups by providing training workshops so that by 1980 a national water quality surveillance network can be operational with the Regional Water Boards having the primary responsibility.

(3) Department of Science and Industrial Research - This agency has at least two primary divisions (chemistry and ecology) devoted to special research on water quality problems. Typical projects have been:

(a) Methods development for chemical analysis;

(b) Recommended water sampling procedures (reference 7, Annex 5). (Developed in conjunction with the Water and Soil Division);

(c) Eutrophication studies;

(d) Land use - water quality studies;

(e) Inter-laboratory quality assurance testing (reference 6, Annex 5).

4.6.3 Proposed GEMS network

A total of three stations were proposed for the GEMS network in New Zealand with the analytical support to be provided by two different laboratories, as outlined in Table 4.6.3.

Table 4.6.3

Proposed GEMS Network - New Zealand

Water Body	Station Location	Participating laboratory	Comments
Waikato River	Outlet from Lake Taupo	Hamilton Science Centre W & S Division	Major lake Relatively unimpacted Upstream control for Waikato River
Waikato River	Mercer	Hamilton Science Centre W & S Division	Multiple uses: hydroelectric agricultural industrial Geothermal impacts Proposed drinking water supply for Auckland
Conterbury Plains Groundwater	Christchurch	Christchurch Science Centre W & S Division	Major water supply for Christchurch Other studies available for relating information

Of the two laboratories proposed for involvement in the GEMS project, only the Hamilton laboratory was visited. Although it was not completely operational (the atomic absoption spectrophotometer and the fume hoods were not yet in place), the laboratory appeared to be quite capable of conducting the type of basic analyses required by the project. The laboratory at Christchurch also reportedly has sufficient capability to meet the requirements of the project. The analysis of selected trace metals and organics would likely be done at the chemistry laboratory of the Department of Science and Industrial Research in Wellington because of the availability of sophisticated equipment and technical expertise at that location (see section 4.6.6).

The country information sheets were partially completed during the consulting visit, and plans were made to complete and mail them to WHO in Manila. It is expected that significant additional comments concerning the issues discussed in section 4.6.1 will be included with the country information sheets.

4.6.4 National coordinating centre

The designated national coordinating centre in New Zealand is the Department of Health. The primary contact is:

Mr John Feltham
Division of Public Health
Department of Health
P.O. Box 5013
Lambton Quay
Wellington
New Zealand

4.6.5 Additional considerations

(1) The Water and Soil Division wishes to receive additional information as soon as possible on the following topics so that they may provide input into the GEMS project development:

- Quality assurance programme guidelines and rationale

- Data handling and statistical treatment - including modelling (see proposed national data system - reference 8, Annex 5).

- Detailed explanation of overall project objectives. This additional supporting material should be sent to Dr M. Taylor through the national coordinating centre (copy to the Health Department).

(2) There is a possibility that New Zealand could provide expert technical assistance in support of the project. Assistance might take the form of WHO-supported workshops in water sampling and analysis utilizing approved quality control practices (both the Chemistry Division of the Department of Science and Industrial Research and the Water and Soil Division of the Department of Works and Development are actively involved in such work).

(3) A question arose concerning the desirability of proposing a water quality monitoring station for the GEMS network in a high, alpine location which would collect primarily snow samples as a truly global baseline reference station. It should be determined if such a station would be desirable for inclusion in the project in the future.

4.6.6 Report of visit to the Department of Science and Industrial Research Laboratories at Wellington and Taupo

The Department of Science and Industrial Research (DSIR) maintains several laboratories which conduct basic and applied research on water quality problems. Two such laboratories were visited during the period 23-27 October 1977. The Chemistry Division laboratory in Wellington provides the greatest capability for water quality analyses in New Zealand. A partial listing of available equipment includes: mass spectrograph, X-ray diffraction unit, spark source spectrograph, high pressure liquid chromatograph, gas chromatograph, atomic absorption spectrophotometers and computer tie-in facilities for several of these units.

The laboratory at Taupo is operated by the Ecology Division of DSIR and is responsible for conducting a wide range of special water quality studies. The staff includes approximately 12-15 scientists, and available equipment includes a wide range of chemical and biological sampling gear (including boats) in addition to laboratory facilities. The analytical capability is not as extensive as that of DSIR chemistry laboratory in Wellington, but support services can be provided as needed.

4.7 Australia

4.7.1 Introduction

A consultation visit to the capital city and several selected state capitals in Australia was made from 28 October to 4 November 1977. The visit began with an interagency meeting at the federal capital in Canberra, Australian Capital Territory. Represented at this introductory coordinating meeting were the following agencies:

Australian Water Resources Council, Department of National Resources

Department of Health

Health Commission, Australian Capital Territory

Department of Environment Housing and Community Development

Discussions at the federal level indicated a high degree of interest in the GEMS project, and provided a broad view of Australia's proposed participation in the project. A schedule was prepared for visits to three state capitals to make the necessary contacts for initiating the project at the required state level. The state agencies will be the groups actually conducting the sampling and analysis programme, whereas the federal role will be to coordinate and transmit data and other information. Discussions were held with the following agencies in the three selected states:

South Australia - Adelaide

(1) Engineering and Water Supply Department

Victoria - Melbourne

(1) State Rivers and Water Supply Commission

(2) Melbourne and Metropolitan Board of Works

New South Wales - Sydney

(1) Water Resources Commission

(2) Metropolitan Water Sewerage and Drainage Board

Due to the fact that most of the state agencies had received little or no information about the GEMS project prior to the visit, numerous questions arose concerning the intent of the project and its usefulness on such a limited basis. Nevertheless, after some clarifying discussions the basic project goals were generally endorsed, and the agencies appeared to be quite willing to cooperate in initiating the project in Australia.

4.7.2 Present monitoring activities

A comprehensive water resource assessment programme is being carried out in Australia through federal grants to the states. Recent emphasis has been given to obtaining a more complete understanding of water quality, and to this end approximately 4000 surface and 4500 groundwater monitoring stations have been or are being developed throughout Australia. (reference 9, Annex 5). This water quality monitoring network is operated in conjunction with a network of approximately 4600 hydrographic stations (reference 10, Annex 5).

4.7.3 Proposed GEMS network

During the consulting visit to Australia 13 existing water quality monitoring stations were proposed for inclusion in the global network. Of these stations, 11 are in rivers, one is in a public water supply reservoir, and one in a large groundwater aquifer. Further details on the proposed stations are shown in Table 4.7.3,and are included in the country information sheets. These sheets are to be completed by personnel at each participating state agency and sent on to Mr Alan Hatfield at the Australian Water Resources Council in Canberra. Mr Hatfield will review the information and then forward it to the WHO Regional Office in Manila.

4.7.4 Laboratory visits

Two laboratories were visited during the consulting visit to Australia - the State Water Laboratories at Bolivar in South Australia and the State Rivers and Water Supply Department Laboratory at Melbourne in Victoria. The Bolivar laboratories were especially impressive with the widespread use of automated analysers for many routine water quality parameters, such as the nitrogen series, phosphorous series, silica, calcium, magnesium, sodium, sulfate, chloride and fluoride. These auto-analysers, as well as some other sophisticated analytical equipment, are to be matched with a computer in the near future in order to optimize the overall laboratory efficiency. In addition, the computerized gas chromatograph-mass spectrograph system with electronic visual display provides this laboratory with the capability for conducting comprehensive analyses for trace organics and other materials. The laboratory had previously participated in quality assurance programmes utilizing check samples from the United States Environmental Protection Agency.

The State Rivers and Water Supply Department Laboratory conducts routine analyses for a wide range of water quality parameters. Personnel at this laboratory are also involved in the development of training courses and other material for improving field sampling and analysis techniques. The laboratory routinely conducts internal checks in order to maintain proper quality control over all analyses.

Table 4.7.3 - Proposed GEMS Stations - Australia

State	Water Body	Station Location	Operating Agency Sampling and Analysis	Comments
1. South Australia	Murray River	Mannum	Engineering & Water Supply Department	Measures combined multiple use impact in Australia's major river system.
2. Victoria	Mitta Mitta River	Hinnomunjie	State River and Water Supply Commission	Baseline station. Upstream control on Murray River
3. - do -	Murray River	Wentworth	- do -	Downstream from multiple use impacts and major tributary (Darling River)
4. - do -	Latrobe River	Rosedale	- do -	Multiple use impact area.
5. - do -	Slip Creek	Coranderrk experimental forestry area	Melbourne & Metropolitan Board of Works	Protected catchment typical of Melbourne's water supply
6. - do -	Yarra River	Warrandyte or Yering	- do -	Control Station for Yarra River Increasing multiple use impacts.
7. - do -	Yarra River	Chandler Highway (Fairfield)	- do -	Intensive multiple use impacts.
8. New South Wales	Murray River	Yarrowonga Weir	Water Resources Commission	Multiple use impacts (espacially irrigation) on middle Murray River.
9. - do -	Darling River	Burtundy	- do -	Drains large area of arid Western N.S.W. into Murray River.
10. - do -	Murrumbidgee River	Below Burrinjuck	- do -	Downstream from reportedly eutrophic reservoir and AWT plant for Canberra.

Table 4.7.3 (cont'd)

State	Water Body	Station Location	Operating Agency Sampling and Analysis	Comments
11. New South Wales	Great Artesian Basin (groundwater)	Northern New South Wales	Water Resources Commission	Major groundwater aquifer in NSW and Queensland.
12. - do -	Lake Burragorang	near dam	Metropolitan Water Sewerage and Drainage Board	Sydney water supply
13. Australia Capital Territory	Molonglo River	Downstream from Canberra AWT plant	To be determined	Measures effect of Canberra AWT plant on receiving water.

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4.7.5 National coordinating centre

The Australian Water Resources Council has been designated as the national coordinating centre in Australia. The official contact is:

Mr Alan Hatfield
Secretary
Australian Water Resources Council
Department of National Resources
P.O. Box 5
Canberra, A.C.T. 2600
Australia

The Department of Health also requested a continuation of the policy of sending them copies of all pertinent correspondence related to the GEMS project. These copies should be sent to:

Director-General of Health
Department of Health
Box 100
Canberra, A.C.T. 2606
Australia

4.7.6 Additional considerations

(1) Various Australian agencies were interested in obtaining information as soon as possible on data transfer procedures from their computerized data storage systems to the WHO collaborating centre at the Canadian Center for Inland Waters. The Australian Water Resources Council recently published a technical document on data transfer systems which may provide useful information for the GEMS project (reference 12, Annex 5).

(2) The State Rivers and Water Supply Commission has developed training material for workshops on field sampling and analytical techniques which may have direct application to proposed WHO training programmes in this important area. Mr Bill Graham of the Laboratory Services Section, has been involved in developing the training material and will forward a proposed course outline to WHO in Manila. Mr Graham also provided a useful document on field sampling and laboratory analysis (reference 11, Annex 5).

(3) Personnel at the Melbourne and Metropolitan Water Board expressed a desire to receive a formal request from WHO (through the Australian Water Resources Council) asking them to participate in the GEMS project. It is suggested that following the Geneva meeting in December 1978, a formal letter be sent to Mr Alan Hatfield outlining the designated GEMS stations and the participating Australian agencies. The letter could be written so that copies could be forwarded by Mr Hatfield to each agency as a formal request for their participation in the project.

4.8 Guam

4.8.1 Introduction

On his return trip to the United States, the consultant stopped off in Guam during the period 19-25 November 1977 to discuss the GEMS project with several interested local agencies. Meetings had been arranged by the Guam Environmental Protection Agency with the following seven agencies:

(1) United States Naval Public Works Center
(2) United States Anderson Air Force Base
(3) Water Resources Research Center
(4) United States Geological Survey (USGS)
(5) Department of Public Health and Social Services
(6) Public Utilities Agency of Guam (PUAG)
(7) Guam Environmental Protection Agency (GEPA)

Each of these agencies was receptive to participating in the GEMS project, especially since there is widespread concern about Guam's available water resources. The primary water resource is groundwater in the northern half of the island which must be monitored closely to detect possible saline groundwater intrusion as development continues in the area. In the south, surface water predominates and constitutes a major military and public water supply source. Increasing attention is being given to further development and protection of this important water resource.

4.8.2 Present monitoring activities

(1) Anderson Air Force Base

A routine monthly water quality monitoring programme is being developed to meet the requirements of the United States Safe Drinking Water Act at nine off-base and two on-base groundwater pumping stations which supply water to Anderson Base. A primary goal is to monitor the possible intrusion of saline water into the freshwater lense as pumping continues. Samples for chemical analysis are sent monthly to the central Air Force Water Laboratory in Texas, United States of America. Bacteriological analysis is presently being conducted on-base using specially-adapted field kits. water samples are split once each quarter with the Guam Environmental Protection Agency laboratory as a means for comparing analyses. In the past the Air Force had conducted special studies on sanitary landfill leachates and on pesticides in surface runoff.

(2) Naval Public Works Center

Naval water quality monitoring activities involve sampling at nine naval waster discharge sites and insuring safe drinking water supplies for naval facilities and part of the general public of Guam. Samples are collected weekly for microbiological analysis of all major tributaries to Fena Reservoir (raw water storage facility), and less frequently for chemical analysis. The laboratory has analysed USEPA check samples in the past at their own request. Special studies of heavy metals, nutrients, pesticides, and other parameters were previously conducted over a period of several years on tributaries entering the harbor from adjacent naval facilities.

(3) Water Resources Research Center

The Center was organized in 1975 in association with the University of Guam. The present four staff members are primarily involved in the conduct of special research projects in fresh waters on Guam (quality of urban runoff, tritium dating of groundwater, groundwater modeling, etc.), and they are gradually developing a capability for water analysis at the Center.

(4) United States Geological Survey

The United States Geological Survey conducts routine stream flow measurements at approximately 10 stations on Guam and at numerous other locations throughout Micronesia. Water level measurements are automatically recorded on punched tape and later converted by computer to discharge values. Results are published annually by the USGS office in Hawaii. Groundwater level measurements and other special studies are also conducted, although minimum water quality data are generated. There is no local USGS water laboratory.

(5) Department of Public Health and Social Services

This department is concerned with the overall health of the general public and especially the safety of public supplies of drinking water, food, drugs, etc. The department operates a clinical laboratory which is primarily concerned with identification of disease bacteria (cholera, typhoid, etc.). At the present time, only a minor amount of work is being done on environmental samples, although, if resources permitted, they would like to greatly increase the monitoring of drinking water supplies in the highly-impacted Marizon area.

(6) Public Utilities Agency of Guam (PUAG)

This agency conducts a comprehensive routine water quality monitoring programme on Guam involving seven wastewater treatment plants and 64 water supply wells. Routine monitoring for the basic test of GEMS parameters (see Annex 7) is conducted on a monthly basis by the PUAG laboratory, but analysis of trace metals and organics must be done at the Guam EPA laboratory.

(7) Guam Environmental Protection Agency (GEPA)

The Guam EPA operates in coordination with the Pacific Southwest Region of the USEPA Office in San Francisco. The Guam EPA is the primary agency responsible for general assessment of water quality in Guam. It works closely with other monitoring agencies by splitting samples for quality control checks and by providing training and laboratory support services. In addition, it conducts a regular monitoring programme on most significant streams and in important bays and estuaries. The Guam EPA also has major responsibilities in several USEPA programmes, such as the Safe Drinking Water Act, Areawide Water Quality Management Planning, and others (see reference 13 in Annex 5).

4.8.3 Proposed GEMS network

The general consensus of the agencies contacted was that two existing monitoring stations should be proposed for the GEMS network. They are listed in order of priority in Table 4.8.3.

Table 4.8.3

Proposed GEMS Network - Guam

	Water Body	Station Location	Participating Laboratory	Comments
1.	Northern Groundwater Aquifer	Near deep test well	Public Utilities Agency of Guam (basic parameters) Guam EPA (trace metals and organics)	Major drinking water supply in Northern Guam
2.	Fena Reservoir	Near dam (Multiple depths)	Naval Public Works Center	Major drinking water supply in Southern Guam

Detailed information sheets were being completed for each station by the participating agencies and were due to be forwarded to WHO in Manila by early December 1977.

4.8.4 Laboratory Evaluation

Of the three participating laboratories, only the Naval Public Works Center and Guam EPA laboratories have the capability to analyse trace metals and trace organics, although the EPA laboratory is still awaiting receipt of the necessary standards for trace organics analysis. The Guam EPA laboratory will support the Public Utilities Agency laboratory by conducting the required trace metals and organics analyses for them. The EPA laboratory will also split samples with the other two laboratories on a regular basis to provide quality control checks. It is presently in the process of achieving primary certification by the United States Environmental Protection Agency, and will, in turn, be assisting the Naval and Public Utilities Agency laboratories in achieving certification as required by the United States Safe Drinking Water Act. In this regard, Mr Ken Morphew, Guam EPA laboratory director, has conducted several training courses for personnel in other laboratories and will be continuing efforts to upgrade the Public Utilities Agency laboratory in the future. Both the Guam EPA laboratory and the Naval Public Works Center laboratory have utilized USEPA check samples in the past for quality control testing.

4.8.5 National coordinating centre

The designated national coordinating center in Guam is the Guam Environmental Protection Agency. The primary contact is:

Dr O.V. Natarajan, Administrator
Guam Environmental Protection Agency
P.O. Box 2999
Agana, Guam 96910

4.8.6 Additional considerations

Due to its experience in quality control work and its probably certification under the United States Safe Drinking Water Act, the Guam EPA laboratory may be able to assist in carrying out the proposed quality assurance programme to be conducted in the Western Pacific Region as part of the GEMS project.

5. ACKNOWLEDGMENTS

The consultant wishes to express his sincere appreciation to the many persons who provided assistance during the country visits. Since it would be difficult to single out a person or group of persons for appreciation, one can only hope that an opportunity may eventually arise for providing the same warm hospitality in return.

ANNEX 1

PERSONS CONTACTED

1. Republic of the Philippines

Laguna Lake Development Authority

Mr Max de Guzman, Senior Research Chemist
Dr Helmuth Lenarz, WHO Limnologist - Advisor
Dr K.M. Yao, WHO Sanitary Engineer - Advisor
Ms Zenaida Villafuerte, Chief of laboratory
Mr Alejandro Santiago, Senior Limnologist
Mr Benedicto Adan, Project Chief

Department of Health

Mr Delfin Gonzales, Chief, Division of Environmental Sanitation
Mr H.K. Chang, WHO Sanitarian
Mr William Ilustre, Senior Engineer
Mr Leo Abcede, Sanitary Engineer
Ms Virginia Sevilla, Chief, Laboratories Division, Bureau of Research and Laboratories
Ms Dorotea Ilustre, Chief, Environmental Health Examination Section Laboratory

Metropolitan Waterworks and Sewerage System

Mr Conrado Cruz, Chief Chemist

Bureau of Public Works

Mr Anacleto Espiritu, Associate Civil Engineer Water Resources Division
Mr Villafria, Chief, Wells and Springs Division

National Pollution Control Commission

Mr Bienvenido Garcia, Officer in Charge
Mr Antoliano Diaz, Chief, Water Pollution Division
Mr Cesar Cabral, Senior Planning Officer
Ms Clarita Centeno, Chief, Research and Development Division

Annex 1

2. Republic of Korea

Ministry of Health and Social Affairs

Mr Kim Jung Hyun, Director, Bureau of Environmental Pollution Control
Mr Moon Sang Ho, Chief, Water Pollution Control Section
Mr Kim Kyu Eung, Water Pollution Control Section
Mr Cho, Chief, Air Quality Protection Section
Mr Ahn Sang Sun, Air Quality Protection Section

Ministry of Construction

Mr Shin Kyong Shick, Director, Water Resources Bureau
Mr Lee Moon Kyu, Water Resources Bureau
Mr Lee, Waterworks and Sewerage Section

National Institute of Health

Mr Ock, Air Pollution Laboratory

Seoul Metropolitan Government Institute of Public Health

Dr Chae Joo Park, Director
Ms Theresa Kim, Chemist and Veterinarian

Kyung Ki Do Provincial Laboratory

Mr Ryu Gun Ryul, Director

Rural Infrastructure Project

Mr David E. MacDonald, Senior Hydrologist with Binnie and Partners consulting engineers, Seoul

WHO Personnel

Dr A.M. Rankin, WHO Representative
Mr R. Harris, Sanitary Engineer assigned to MOC
Dr W. Kreisel, Air Pollution Specialist assigned to MOHSA
Dr K.M. Patwary, Statistician assigned to the project KOR/DHS/001

Annex 1

3. Japan

Ministry of Health and Welfare

Mr Shinji Kaneda, Director, International Affairs Division, Minister's Secretariat
Mr Isao Saito, Deputy Director, International Affairs Division, Minister's Secretariat
Mr K. Kunikawa, Director-General, Water Supply and Environmental Sanitation Department
Mr T. Fujita, Director, Planning Division, Water Supply and Environmental Sanitation Department
Mr K. Yamamura, Director, Water Supply Division, Water Supply and Environmental Sanitation Department.
Dr D. Suzuki, Deputy Director, Planning Division, Water Supply and Environmental Sanitation Department
Mr H. Sakamoto, Deputy Director, Water Supply Division, Water Supply and Environmental Sanitation Department
Mr D. Sugito, Deputy Director, Planning Division, Water Supply and Environmental Sanitation Department
Mr Hiroaki Takagi, Planning Division, Water Supply and Environmental Sanitation Department
Mr S. Kato, Planning Division, Water Supply and Environmental Sanitation Department
Mr K. Yokoo, Water Supply Division, Water Supply and Environmental Sanitation Department

Ministry of Construction

Mr T. Kobayashi, Deputy Director, River Planning Division, River Bureau
Mr Osamu Arai, Deputy Director, River Planning Division, River Bureau
Mr Tadashi Kosaka, Director, River Improvement Division
Ms N. Mitsuhashi, International Affairs Division, Planning Bureau
Mr S. Sato, River Planning Division, River Bureau

Environment agency

Mr T. Sakaki, Deputy director, International Affairs Division, Minister's Secretariat
Mr T. Katayama, Deputy Director, Water Quality Management Division, Water Quality Bureau
Mr T. Shimizu, Deputy Director, Water Quality Control Division, Water Quality Bureau
Mr Y. Sawatari, Deputy Director, Water Pollution Control Division
Mr K. Hosaka, Water Quality Management Division

Annex 1

Institute of Public Health

Dr Shoichi Nambu, Chief, Department of Sanitary Engineering
Mr Yasumoto Magara, Section chief, Department of Sanitary Engineering
Dr S. Kunikane, Department of Sanitary Engineering

Yokohama Waterworks Bureau

Mr Komatsuzaki, Director, Water Purification Department
Mr Keisaburo Nakayama, Chief Engineer, laboratory of water examination
Mr Yasuji Kaneda, Chief Engineer

Kanagawa Prefecture Waterworks Board

Mr Goro Koide, Chief of laboratory, Water Research Centre
Mr Handa, Water Pollution Control Section, Environmental Department
Mr Sagiyama, Water Pollution Control Section, Environmental Department

Annex 1

4. Malaysia

Division of Environment

Mr Maheswaran
Mr Abu Bakar Jaafar

Drainage and Irrigation Department

Mr Phuah Kim Heng, Engineer, Hydrologic Data Collection
Mr Khoo Soo Hock, Chief Planning Engineer

Chemistry Department

Mr Singh, Director-General
Mr S. Sinnappa, Senior Chemist

Forestry Department

Mr Mok Sian Tong
Mr Cheah L.C., Director, Silvicuture unit

Geological Survey Department

Mr Santoch Singh, Deputy Director-General

Department of Public Works

Mr Chan Book Teik, Director, Water Supply Division

Universiti Pertanian Malaysia

Dr Arffin Bin Suhaimi, Dean, Faculty of Science and Environmental Studies
Mr Wong Kien Keong, Lecturer, Department of Environmental Studies
Mr Sulaiman Noordin, Head, Department of Environmental Studies
Mr Tan Wee Lee, Instructor, Chemistry Department

Ministry of Health

Mr A. Sekarajasekaran, Chief, Environmental Health and Engineering Unit
Mr K. Rishyakaran, Public Health Engineer

WHO Personnel

Dr L.R.L. Verstuyft, WHO Representative
Mr Pierre Lauriault, Sanitary Engineer assigned to Environmental Health and Engineering Unit

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Annex 1

I. New Zealand

Department of Health

Mr Max Collins, Director, Division of Public Health
Mr Lew Thorstenson
Mr John Feltham

Water and Soil Division, Ministry of Works and Development

Mr Ken Mitchell
Dr Mike Taylor
Mr John Waugh, Hydrologic Section
Mr J.S. Neilson, Hamilton Science Center

Department of Scientific and Industrial Research

Chemistry Division - Wellington

Dr Craig Stevenson
Freshwater Section of Ecology Division - Taupo
Mr Ed White, Chief
Dr Mike Timperley
Mr Peter John

Commission for the Environment

Dr Philip Tortell

Auckland Regional Authority

Mr Don Wilson, Manager and Chief Engineer
Mr Arthur Haughey
Mr Tom Shaw, Chief Chemist, Potable water pilot plant

Annex 1

6. Australia

Canberra, Australian Capital Territory

Mr Alan Hatfield, Australian Water Resources Council
Ms Jan Angel, Australian Water Resources Council
Mr Bert Klassen, Australian Water Resources Council
Mr Howard Rose, Australian Water Resources Council
Dr Pauline Philpott, Department of Health
Dr Annersley Crowe, Health Commission, Australian Capital Territory
Mr Richard Procter, Department of Environment, Housing and Community Development

Adelaide, South Australia

Mr David Pearce, State Water Laboratories
(Formerly Engineering and Water Supply Department Laboratories)
Mr Gavin Woods, State Water Laboratories
Mr Don Bursill, State Water Laboratories

Melbourne, Victoria

State River and Water Supply Commission

Mr Frank Taylor, Chief, Engineering Development and Planning Branch
Mr Wayne Drew, Chief, Laboratory Services Section
Mr Bill Graham, Laboratory Service Section
Mr Jeff Smith, Hydrographer

Melbourne and Metropolitan Water Board

Mr Charles Wilks, Chief Engineer, Operations and Maintenance
Mr Neil Howard, Engineer for Investigations, Planning and Research (IPR), Water Supply Department
Mr John Langford, IPR, Water Supply Department
Mr Roger Vass, IPR, Water Supply Department
Mr Pat O'Shaughnessy, Research Forester

Sydney, New South Wales

Water Resources Commission

Dr David Garmen, Research Officer
Mr Simon Pels, Acting Principal Research Officer

Metropolitan Water Sewerage and Drainage Board

Mr Bruce Tuxford, Senior Chemist

Annex 1

7. Guam

Environmental Protection Agency

U.S. Naval Public Works Center

Lt Commander Lowell Norris, Production Officer
Mr Ernie Capaldo, Environmental Control Officer, Planning Group
Mr Ralph Lytle, Head, Laboratory Services

Water Resources Research Center

Dr Steve Winter, Director
Mr Bill Zolan, Environmental Health Specialist
Mr Russell Clayshult, Biological Aide

U.S. Geological Survey

Mr Chuck Huxel, Hydrologist (groundwater)
Mr Otto Van der Brug, Hydrologist (surfacewater)

U.S. Anderson Air Force Base

Captain Ronald E. Hergenrader, Bio-environmental Engineer
Mr Rufino Landyan, Environmental Coordinator

Department of Public Health and Social Service

Mr John Rosario, Administrator
Mr Tony Evidente, Chief
Mr George Muna, Supervisory Environmental Health Technician
Ms Angie Roman, Acting Director, Public Health Laboratory

Public Utility Agency of Guam

Mr Ricardo Guerrero, Director

Guam Environmental Protection Agency

Dr O.V. Natarajan, Administrator
Mr Jim Branch, Deputy Administrator
Mr Ken Morphew, Laboratory Director
Mr Gary Stillberger, Marine Biologist
Mr Fred Flohrschutz, Chief, Water Division

ANNEX 2

INTER-MINISTRY MANAGEMENT COMMITTEE FOR WHO GLOBAL WATER QUALITY MONITORING PROJECT IN JAPAN

Ministry of Health and Welfare

International Affairs Division (Window to WHO) (Mr. Saito)
Planning Division (Secretariat) (Mr Suzuki, Mr Sugito, Mr Kato, Mr Takagi)
Water Supply Division (Mr Sakamoto, Mr Yokoo)

Ministry of Construction

International Affairs Division (Mr Mitsuhashi)
River Planning Division (Mr Kobayashi, Mr Arai, Mr Sato)

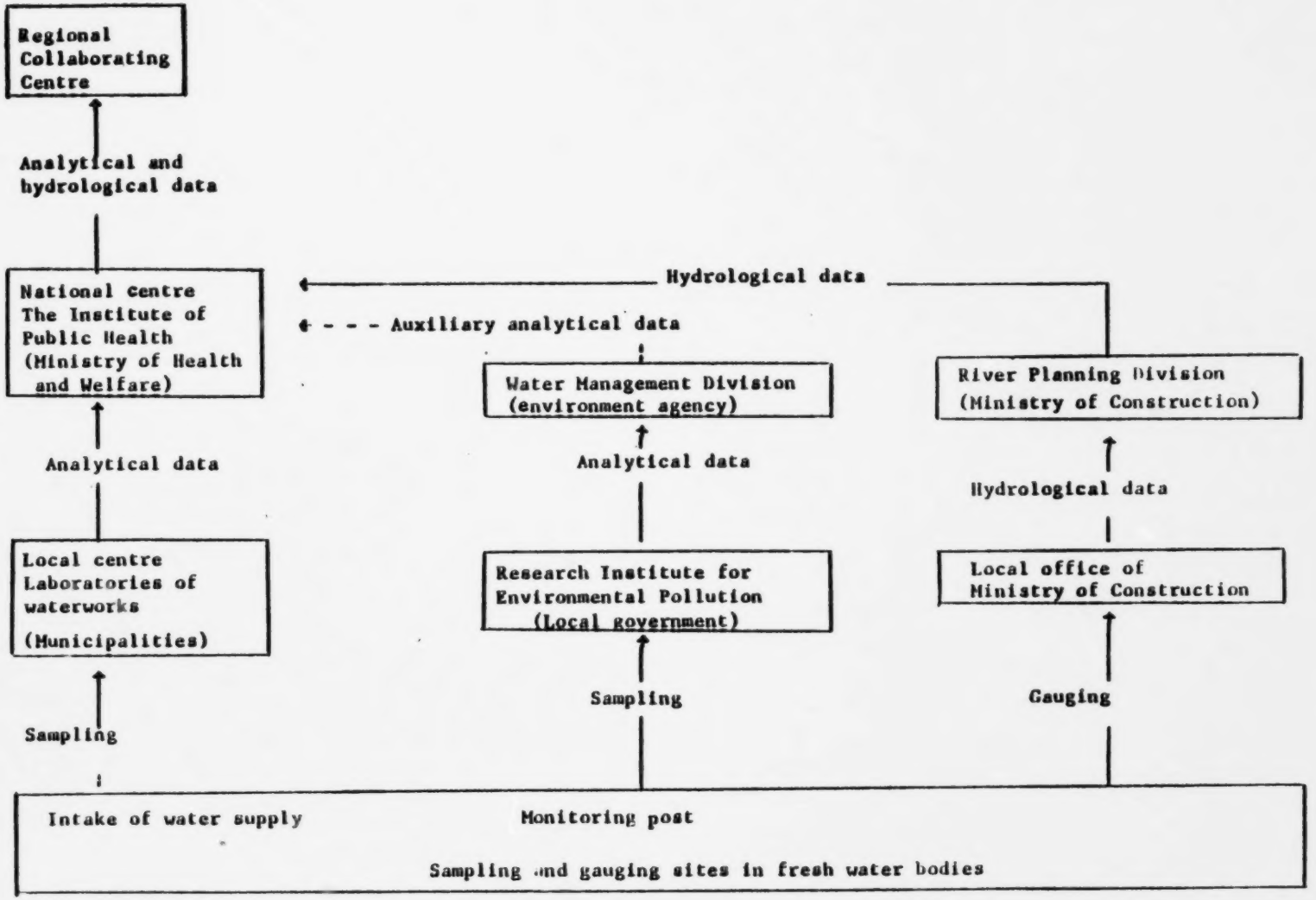
Environment Agency

International Affairs Division
Water Quality Management Division (Mr Katayama, Mr Hosaka)
Water Pollution Control Division (Mr Sawatari)

The Institute of Public Health (National Centre)

Department of Sanitary Engineering (Dr Nambu, Mr Magara, Dr Kunikane)

DATA FLOW IN JAPAN FOR THE GLOBAL WATER QUALITY MONITORING PROJECT


Regional Collaborating Centre
Analytical and hydrological data
National centre The Institute of Public Health (Ministry of Health and Welfare)
Hydrological data
Auxiliary analytical data
Water Management Division (environment agency)
River Planning Division (Ministry of Construction)
Analytical data
Analytical data
Hydrological data
Local centre Laboratories of waterworks (Municipalities)
Research Institute for Environmental Pollution (Local government)
Local office of Ministry of Construction
Sampling
Sampling
Gauging
Intake of water supply
Monitoring post
Sampling and gauging sites in fresh water bodies

ANNEX 4

MEMBERS OF THE AD HOC TECHNICAL SUB-COMMITTEE FOR GEMS PROJECT COORDINATION IN MALAYSIA

1.	Mr A. Sekarajasekaran (Chairman)	Ministry of Health
2.	Mr Lum Weng Kee (Secretary)	Ministry of Health
3.	Mr S. Sinnapa	Department of Chemistry
4.	Mr Chan Boon Teik	Public Works Department
5.	Mr Abu Bakar Jaafar	Division of Environment
6.	Mr Cheong Chup Lim	Drainage & Irrigation Department
7.	Mr Phuah Kim Heng	Drainage & Irrigation Department
8.	Mr Mok Siang Tong*	Department of Forestry
9.	Mr Santokh Singh*	Geological Survey Department

* Proposed members.

ANNEX 5

MAJOR REFERENCE DOCUMENTS

Republic of Korea

1. The Seoul Metropolitan Government Institute of Public Health, "The Report of Seoul Metropolitan Government Institute of Public Health," Seoul, Republic of Korea, 1975.

Japan

2. Environment Agency, "Quality of the Environment in Japan - 1976," Tokyo, Japan, 1976.

Malaysia

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5. Universiti Pertanian Malaysia, "Environmental Studies - Universiti Pertanian Malaysia", Faculty of Science and Environmental Studies, December, 1976.

New Zealand

6. Kingsford, M., C.D. Stevenson and W.H.L. Edgerley, "Collaborative Tests on Water Analysis (the Chemaqua Programme) 3. Sodium, potasium, calcium, magnesium, chloride, sulphate, bicarbonate, silica, conductivity and ph", Report No. C.D. 2242, Chemistry Division, Department of Scientific and Industrial Research. Lower Hutt, New Zealand, February 1977 (two other similar reports are available).

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8. Water and Soil Division, "Proposals for a Water Quality Data Storage and Retrieval System", Ministry of Works and Development, Wellington, New Zealand, 1977.

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Australia

9. Australian Water Resources Council, "AWRC Activities 1976," Department of National Resources, Canberra, Australia, 1977.

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11. Environment Protection Authority, "A Guide to the Sampling and Analysis of Water and Wastes", Report No. 23/77, Melbourne, Victoria, Australia, 1976.

12. Australian Water Resources Council, "Standards for Interchange of Water Resources Data on Computer Media," Department of National Resources, Hydrological Series No. 10, Canberra, Australia, 1976.

Guam

13. Guam Environmental Protection Agency, "Fourth Annual Report, April 1976 - March 1977", Guam 1977.

ANNEX 6

INDEX OF MAPS AVAILABLE IN GEMS PROJECT FILES

Korea

1. Establishment place of water Quality Monitoring
2. Topographical map of Seoul metropolitan area

Japan

3. Map of proposed GEMS station in Japan

Malaysia

4. River water quality stations in Peninsular Malaysia 1976 (proposed GEMS stations are identified)

New Zealand

5. Waikato River Basin

Australia

6. Stream gauging stations - Victoria, State Rivers and Water Supply Commission, 1977 (proposed GEMS stations are identified)

7. Catchments of major watercourses, Melbourne and Metropolitan Board of Works, 1975 (proposed GEMS stations are identified)

8. Melbourne and Metropolitan Board of Works, Stream Monitoring Programme, Yarra River and Tributaries

9. Sampling Programme - quality of surface water resources of New South Wales, Water Resources Commission, 1975

10. Water Conservation and Irrigation Works - New South Wales, Water Conservation and Irrigation Commission 1972 (proposed GEMS stations are identified).

11. Map showing board's area of operations, Metropolitan Water Sewerage and Drainage Board, Sydney, New South Wales, 1977.

ANNEX V

WATER QUALITY PARAMETERS FOR GEMS PROJECT

	Basic parameters	Rivers	Lakes	Groundwater
1.	Temperature	+	+	+
2.	pH	+	+	+
3.	Transparency	+	+	-
4.	Electrical conductivity	+	+	+
5.	Dissolved oxygen	+	+	+
6.	Chloride	+	+	+
7.	Alkalinity, total	+	+	+
8.	Calcium	+	+	+
9.	Magnesium	+	+	+
10.	Suspended solids	+	-	-
11.	Volatile suspended solids	+	-	-
12.	Nitrogen, ammonia	+	+	+
13.	Nitrogen, nitrate & nitrite	+	+	+
14.	BOD	+	-	-
15.	Phosphorous, ortho-phosphate (soluble reactive)	+	+	-
16.	Chlorophyll a	-	+	-
17.	Phytoplankton (volume)	-	+	-
18.	Faecal coliform bacteria	+	+	+

Globally-significant parameters (total and dissolved in water; sediments; relevant biota)

	Heavy metals	Organochlorine compounds
1.	Cadmium	DDT, DDD, DDE
2.	Mercury	Dieldrin, Aldrin, PCB's
3.	Lead	Hexachlorocyclohexane isomers (BHC)

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